OPERATING A RECORDING SCHEME

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INTRODUCTION

The water beetle recording scheme was officially launched in 1979 under the auspices of both the Biological Records Centre (BRC) and the Balfour-Browne Club, a group devoted to the study of water beetles. Preparatory work for the scheme had been going on since 1972, when the prospect of a national scheme, as opposed to a series of local schemes, was first contemplated. Initial work involved transfer of as much as possible of Professor F. Balfour-Browne's vice-county recording data onto BRC record cards. Thus, a good base of records, albeit mainly pre-1950, was quickly acquired so that the prospect of complete coverage of Britain and Ireland was possible.

TAXONOMY

Water-living beetles occur in several families of which a few are exclusively aquatic (Haliplidae, Hygrobiidae, Noteridae, Dytiscidae, Gyrinidae — the Hydradephaga; plus the Hydraenidae and Elmidae) and some are almost exclusively amphibious (Hydrophiloidea, Dryopidae). Smaller groupings such as the Donaciinae and aquatic weevils have later been added to the record card so as to get fuller site lists, and others (e.g. Microsporidae, Georissidae) have been added for the sake of convenience and completeness. Others, particularly the Scirtidae, have been left off for the sake of convenience too! This follows the tradition of Balfour-Browne, who ignored aquatic *Cercyon* and riffle beetles (Elmidae) during a lifetime of fieldwork. However desirable it might seem to the outsider to have a recording scheme based on habitat, most of the beetle recording schemes are based on particular families.

It is not easy to specify how many water beetles species there are if one records by habitat rather than by family. The present record card lists 323 species. Since 1972, 14 species have been discovered new to the British fauna. Seven species reckoned to be extinct have been rediscovered. Of the new species six have been 'de-lumped', i.e. recognized as having specific status in complexes lumped together by Balfour-Browne. A source of unexpected new species has been the 'monospecifics', i.e. species considered to be so distinct that no-one in the past had checked whether they might comprise a cryptic species-pair. There have been several examples among water beetles, the most recent being *Hydrochus megaphallus* van Berge Henegouwen, recognized as distinct from *H. brevis* (Herbst)(van Berge Henegouwen, 1988). The subtle habitat and distributional segregation associated with such sibling species make them the most interesting to record on a national basis.

Most recorders are only too willing to accept the need for name changes if these involve additions to the fauna, but they are less inclined to accept the endless series of name changes rendered necessary by interpretation of the International Code of Zoological Nomenclature (ICZN). There have been 17 changes in specific epithets since 1972 and that does not include the comparatively trivial change from names ending in '-i' to '-ii'. Revisions of genera have resulted in eight generic name changes, one of which has caused a species to lose its name completely when it coincided with a change in the specific epithet as well. One genus, *Potamonectes* has recently changed in name for the second time — to *Nebrioporus* (Nilsson & Angus, 1992). Such changes should be welcomed as they demonstrate the intensity of academic study on the group. An important victory for ecologists in 1990 was conservation of the name *Helophorus brevipalpis* Bedel for the commonest British water beetle when ICZN suppressed an earlier, unused name that should have had priority (ICZN, 1991). Taxonomists care about stability and they change names only when absolutely necessary.

QUALITY OF RECORDS

Record quality is one of the most time-consuming aspects of running a scheme and it is dangerous, but necessary, to make some generalizations about it. The ability to use keys accurately appears to be a gift not necessarily associated with academic ability — perhaps it is more to do with either patience or focal length! However, willingness to accept that one could have made a mistake, and that therefore it is necessary to keep vouchers and to submit them for expert identification, must surely be associated with some aspect of intelligence. Coleopterists keep voucher material because, for most, the collection is an underlying reason for the activity. It has to be said that the worst quality records appear in some learned journals; many professional ecologists attempt to cover too many groups of organisms without seeking expert guidance; voucher material, if retained at all, tends to be lost at the end of a research project or contract. Editors of learned journals would do well to extend refereeing to include the correct identification and preservation of voucher specimens.

Voucher preservation

Coleopterists mount on cards or pin dried material and accumulate series of each species. This makes comparison between specimens very easy, but these fragile husks are difficult to dissect. Professional ecologists tend to preserve site collections of aquatic material in either alcohol or formalin. Compromises between these two approaches are unsatisfactory. Specimens stored loose in tubes achieve only the main purpose of long-term storage of vouchers. Specimens stored individually in spirit take up too much space and are not easily compared.

The best policy must be to have both a dry-mounted collection organized by species and alcohol-preserved material, even of the commoner species, for each site visit. Constant reference to the dry material maintains awareness of species differences whereas the spirit collection, which need not occupy much space, proves invaluable when cryptic species-pairs and similar problems are later recognized.

Correct identification

The streamlined shape of many water beetles makes it difficult to provide keys based on general appearance. Size is, however, of considerable value in reducing the number of possibilities when running a specimen through a key. Many beginners do not appreciate this and mistakes in using Laurie Friday's keys (1988) often stem from failure to use the size chart provided.

Simple keys do not work within many genera, and some species cannot be identified without dissection of the genitalia. Usually the male genitalia are the more distinctive, but occasionally female genitalia, particularly in whirligig beetles (*Gyrinus* spp.), are also of value.

Field experience allows one to recognize each species by a series of characters concerned with colour, size and shape. Occasionally added to this array are the behaviour of species (e.g. the way in which some species hide in netted debris whereas others attempt to escape), the way in which water runs off the body (e.g. in streaks over the elytra of

Agabus with elongated reticulation patterns) and even characteristic smells, such as those of *Ilybius fenestratus* and *I. aenescens*. With this experience comes the ability to assemble large lists at sites without the need to destroy many of the commoner species.

Identification service

This free service to Club members is important in maintaining interest. In the period September 1984 to August 1992, 47 438 specimens in 382 batches were identified by the author, to which must be added the voluntary identification work of other members. The scale of the exercise underlines the risk of generating errors. Even if identification was 99% accurate, about one beetle has been misidentified each week for 10 years. To this must be added the risk of clerical error, usually committed when transcribing data, by striking through the wrong species names on the card.

Record age

The usefulness of a data-base varies with how it is used. The decision-maker concerned with habitat protection wants to know about the present state of a site, though he or she might be prepared to overlook the age of records if intent on making a case for conservation. The rapidity with which sites of conservation value have been damaged from the 1970s onwards has caused conservationists to question the value of maps distinguishing records before and from 1950 onwards. Narrowing the distinction to post-1970, or as often requested now, post- 1980 records, usually demonstrates the patchy decanal coverage rather than providing useful information on the extent to which a species is changing in distribution.

The best way of distinguishing the traditional amateur entomologist from the one primarily concerned with conservation ought to be the weight placed on records. The enthusiast undoubtedly reveres the **first** record for an area whereas the conservationist should surely value most the **last** record.

This logic might force us to the disagreeable conclusion that we are all mere collectors rather than true conservationists. However, there are not enough recorders to monitor sites, and some of us rarely visit the same site twice, claiming as an excuse the need to achieve better coverage. The compromise must be for rarer species to be repeatedly 'rediscovered' in order to maintain interest, and this is precisely what happens.

The other compromise is that more effort has been put into acquiring new records for the scheme rather than scouring museum collections and journals for old records. The entomologist adopting the traditional approach will always be able to identify gaps in the maps based on older records.

Quality and the computer

The problems of inputting and retrieving data are beyond the scope of this article, largely because none of the estimated 170 000 records* is computerized, except for the purposes of assemblage analysis. This is not because of any Luddite attitude, but simply

* Note added in proof

Since this paper was written, about 15 000 water beetle records have been entered on computer using the RECORDER package (Ball, S.G. 1992. RECORDER Version 3.1. Peterborough: English Nature). These records cover north-west England and the work was supported by JNCC. Henceforth, all newly acquired records will be computerised as soon as they are received. Funding is being sought on a regional basis to computerise the remaining 155 000 records.

through lack of sufficient resources at BRC. Having said that, it is important to note that there is no such thing as a 'backlog' in the sense of data awaiting input to a computer. Records received are immediately transferred to dot maps by hand, and the filing cards are soon stored in order of grid reference, site and date. Records for a site can be retrieved as quickly from a filing cabinet as from a computer data-base. Unfortunately, one decision taken as a short cut at the outset of the scheme was not to keep maps for the commoner species. To attempt to assemble such maps without the aid of a computer would now be absurd. The other main reason for data input to a computer, despite the potential for yet further transcription errors being incorporated into the data-base, is to replicate the information. Network access to the data-base, if that involves interpretation of data by uninformed staff, is looked upon as a disadvantage rather than an advantage.

QUANTITY AND COMPLETENESS

Records of aquatic Coleoptera are acquired by several types of people. The tradition of amateur collecting of Coleoptera is best developed in Britain and Germany. Professional entomologists visiting the UK usually express surprise and envy at the intensity of beetle recording. The accuracy with which amateur coleopterists identify beetles is unfortunately often offset by proprietoriality and a reluctance to reveal the secrets of what is essentially a secretive and individual pursuit. Another problem is that such enthusiasts have no interest in common species and so fail to make complete lists during site visits.

Professional limnologists, on the other hand, usually attempt to record all taxa at each site, and rarely spend enough time searching for Coleoptera, many species of which are confined to extremely shallow water not easily worked by sweeping with a pond net.

The most comprehensive lists are provided by specialist enthusiasts, of whom the first was Professor Balfour-Browne. Within any decade this century, rarely more than two or three such recorders have been active. Even now, the 'inner core' of those whose site visits are almost exclusively dedicated to water beetles is small. Some of the most effective are visitors to Britain, who record more avidly than local entomologists, just as a British collector might make the most of a stay abroad. The water beetle data-base is best used as an accumulation of records; we are not really in a position to provide 'snapshot' surveys of common species though recent collaboration with the Institute of Terrestrial Ecology's Countryside 1990 Survey has demonstrated that this is possible with sufficient resourcing.

REASONS FOR RUNNING THE SCHEME

One is always tempted or even coerced into providing a rationale for one's actions. As far as assembling a large recording database is concerned, it is important to identify natural curiosity as the first reason for recording activity, the second being that such an outdoor pursuit provides a substitute for the atavistic pleasure of hunting. To quote Charles Darwin (1871): 'Whenever I hear of the capture of rare beetles, I feel like an old warhorse at the sound of a trumpet'.

The collecting instinct, for the beetles, the records or both, should be added and the whole summarized as 'fun'. If recording can in some way be used to insure that future generations also enjoy the same degree of pleasure then there is plenty of justification for the activity. However, if the mapping scheme organizer contributes most of the time and effort without charge, 'Why not?' is as good a reply as any to 'Why?' What follows is a bonus.

Speculation about distribution

Some people, including scientists, appear to derive pleasure from speculation. Speculation as to why animals are distributed in the way that they are is a popular activity, unfortunately often rendered disagreeably contentious by adherence to a favourite theory. It can be claimed that water beetle distributions fall into a limited number of types. Balfour-Browne (1940) recognized five (British, English, South-East, South-West and Scottish) as a result of his British vice-county recording programme for Hydradephaga. Despite intensive recording since then, with many exciting discoveries, the distribution of most species still conform to the types identified by Balfour-Browne. Certain unusual distributions detected by Balfour-Browne, e.g. that of *Agabus didymus* (Olivier) being found much further north on the east side of Britain than on the west (Figure 1), are almost identical to the present 10-km maps (Figure 2). Balfour-Browne (1950) commented on *A. didymus* as an example of a species 'gradually spreading westwards and northwards'. The commonness of the species on Anglesey (where Balfour-Browne could not find it in 1914) and recent records for Lancashire might be seen as fulfilling this prophecy. Balfour-Browne also stated that he 'would not be surprised if, within a few years, the species is recorded from south-east Scotland, if anyone is enthusiastic enough to do some special collecting in that area.' He did not then know of specimens taken at Coldingham in 1939, but not identified until much later (Owen, 1952).

At that time, Balfour-Browne entered into controversy with Dorothy Jackson, whose studies on flight capacity (Jackson, 1952) indicated that many species were not at all dynamic in their distributions. Subsequently many of Jackson's 'flightless' species have been found to include individuals capable of flight.

However, the basic idea remains that some distributions can be explained as the residue of wider ones associated with optimal conditions for many warmth-loving species occurring after the retreat of the ice cap. Balfour-Browne's ideas of constant reinvasion and movement hold good for pioneer species, with at least one well-documented example of a species colonizing Britain (*Coelambus nigrolineatus)* (Steven) in man-made quarry ponds and gravel pits, first found in 1983 by Carr (1984) in East Kent, and now known from East Sussex, Oxfordshire, Suffolk and Northamptonshire).

Special recording problems

Certain distributions, in particular those of some subspecific forms, are of special interest and have potential for interpreting the ways in which Britain has been colonized by insects. These forms provide an opportunity for enthusiasts to contribute to studies of distributional phenomena, supplementary to specialist studies of Holocene subfossil material and genetic diversity.

Two forms of *Nebrioporus* (formerly *Potamonectes*), *depressus* Fab. and *elegans* (Panzer) can be differentiated with confidence only by reference to the aedeagus, broad- and blunt- ended in the former and narrowly tapering in the latter. Where these forms coexist, in southern Scotland (Balfour-Browne, 1919) and in northern Germany (Franck, 1935), they intergrade in morphology, with some sites characterized by particular grades within what has become known as the '*depressus-elegans* complex'. The true *N. depressus* occupies relict lochs (and Talkin Tarn in Cumbria) and *N. elegans* may occupy neighbouring running water and man-made lakes, the presence of intergrading forms suggesting a dynamic balance between the two (Shirt, 1981). This idea is strengthened by the true *N. elegans* being absent from Ireland, where *N. depressus* occupies a much wider range of habitats.

Some dytiscids have females with two different forms of microreticulation. The finely reticulate, matt forms tend to be northern in distribution, e.g. *Agabus uliginosus* var. *dispar* Bold, with the shiny, male-like forms being southern. An interesting exception is *Hydroporus memnonius* Nicolai, the matt form of which (*castaneus* Aubé) being the commonest British form, with the male-like form being restricted to Ireland, Anglesey, most of Scotland, and some sites in Wales and the Lake District. The transition zone is in the area of the Scottish/English border with both forms coexisting over a wide area. This suggests that the matt form colonized Britain later than the shining form. It is thus important to record such forms, particularly in the case of *H. memnonius*, where the shining form can be regarded as having greater conservation value.

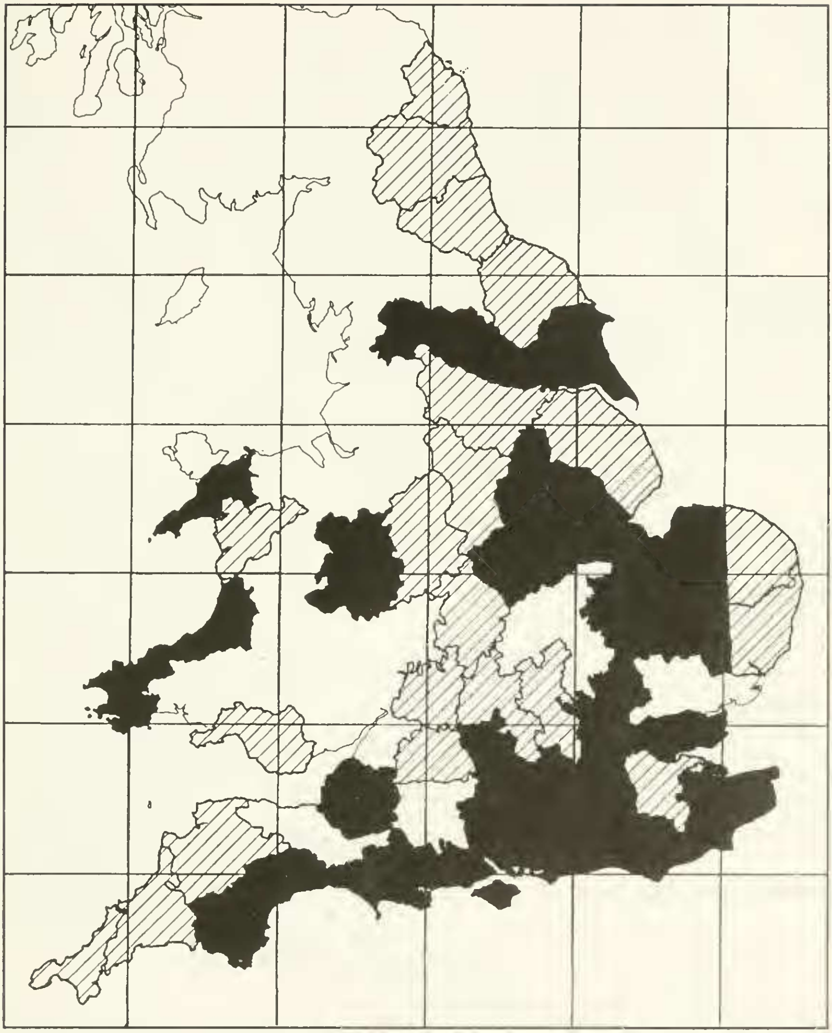

Figure 1. The vice-county distribution of *Agabus didymus* (Olivier) (Coleoptera, Dytiscidae) as recorded by F. Balfour-Browne (1950). Black areas represent vice-counties for which Balfour-Browne had confirmed records; hatching represents unconfirmed records.

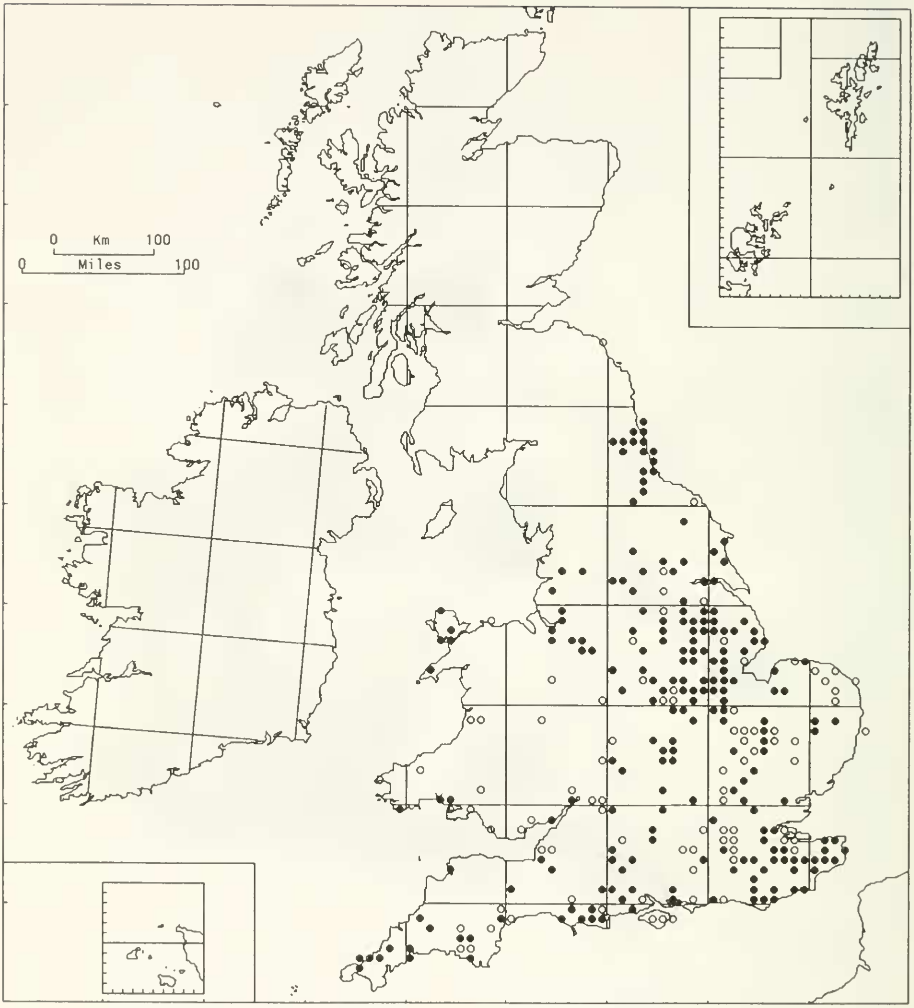

Figure 2. The 10-km square distribution of *Agabus didymus* as known in 1992. Open circles refer to records before 1950; filled circles represent post-1950 records.

The most interesting example of cryptic species also illustrates some of the problems of the recording scheme. Van Berge Henegouwen (1986) split the commonly occurring hydrophilid *Anacaena limbata* (Fab.) into two species, *A. limbata* s.s. and *A. lutescens* (Stephens), mainly on the basis of the hair cover of the hind femora, an underside character not visible in dry-mounted material (and often obscured by glue when a specimen is dismounted). Thus records of '*Anacaena limbata*' previous to this discovery largely became redundant. This is an important reason for dating the completion of a card, something that is still not being done! Laborious reinspection of dry-mounted museum material is, of course, possible, but such common species are not usually well represented in collections. It has proved far more effective to re-examine alcohol- preserved material, for which there is less inhibition about accumulating common material, and which can be identified more easily than card-mounted specimens. It will be interesting to see to what extent Coleoptera enthusiasts have begun to mount hydrophilids on their side or upside down in the interests of assisting identification.

Van Berge Henegouwen also noted that males were generally rare in *A. lutescens*, and had not been detected in acid waters. Shaarawi and Angus (1991) have subsequently demonstrated that a dark female form has a different karyotype from *A. lutescens* females associated with males, one chromosome pair being heterozygous, with a high proportion of individuals being triploid. Thus our cryptic species pair apparently includes a third member, the parthenogenetic female form of *A. lutescens*. This raises another problem for the recorder. As the aedeagi of *Anacaena* have not proved useful in identification, they are rarely dissected; dry-mounted material can sometimes be sexed, but one really wants a series of specimens from each site in order to increase the probability of proving whether or not a population is bisexual.

The distributions of *A. limbata* and *A. lutescens* (Figures 3 and 4), derived from a smaller data-base than for most water beetle species, are clearly different, with *A. limbata* being the fenland drain species. *A. lutescens* is the more widely distributed species, and males, although common in Northern Ireland, have not yet been detected from Scotland or northern England.

Other reasons for recording

Apart from the pleasure of acquiring and speculating about records, a rationale for running a scheme which results in species mapping can be summarized easily:

1 to validate rarity/vulnerability statuses of species and sites;
2 to aid interpretation of species' requirements;
3 to provide a data-base so that changes can be detected;
4 to identify and thus to promote the study of unrecorded areas;
5 to link to other European mapping schemes.

It is also important to identify the way in which a fuller use can be made of the data-base by analysing species lists.

Assemblage analysis

The well-defined nature of most aquatic sites, and the diversity of beetles associated with virtually all non-marine aquatic habitats, provide the potential to evaluate all wetlands in a single analysis of water beetle site lists. Some 2 100 lists have so far been analysed on a regional basis in Britain (Foster & Eyre, 1992). About 300 have also been analysed for Ireland (Foster *et al.*, 1992). The classification of lists into groups can be achieved objectively by use of TWINSPAN (Hill, 1979a) and other programs of multivariate analysis. Once divided into groups, the site lists can be ranked using a species-quality score and other attributes (Foster *et al.*, 1989, 1992). It is thus possible to offer a rationale for site selection for conservation, including a structure within which to place lists from newly recorded sites and damaged sites.

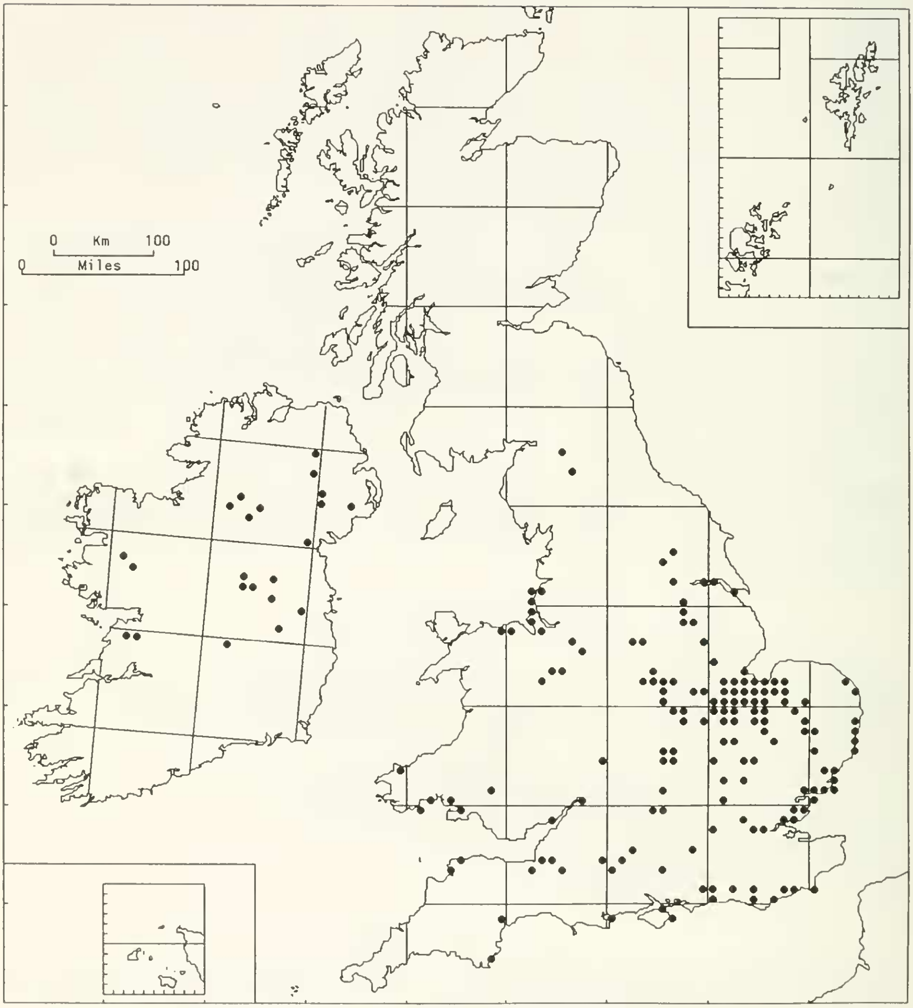

Figure 3. The 10-km square distribution of *Anacaena limbata* (Fab.) s.s. (Coleoptera, Hydrophilidae). Filled circles represent all records regardless of date.

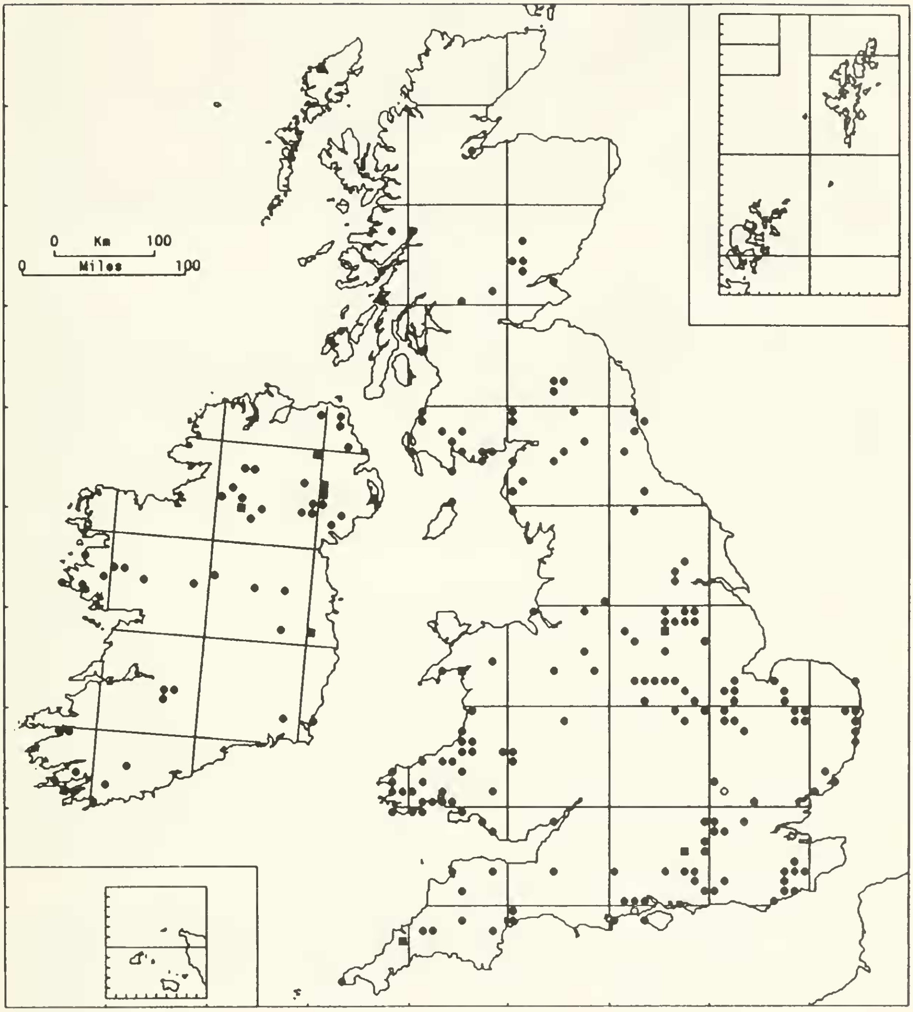

Figure 4. The 10-km square distribution of *Anacaena lutescens* (Stephens) Coleoptera, Hydrophilidae), males being indicated where recorded, by a filled square. Open circles represent records before 1950; filled circles represent post-1950 records.

The multivariate approach is also important in identifying the ecological variables dictating community type and species preference. Detrended correspondence analysis (DECORANA — Hill, 1979b) can be used to ordinate sites and species on a series of axes which represent the hierarchy of environmental gradients dictating community type. Obvious environmental factors, such as salinity, flow and substratum are identified as important in most such analyses, but this objective method of analysis often identifies the importance of water permanence and distance from permanent water bodies. GLIM (Generalized Linear Interactive Modelling — Baker & Nelder, 1978) has been used to analyse the probability of occurrence of individual species as adults and larvae in relation to site water duration (Eyre *et al.*, 1992).

In the absence of experimental evidence to validate site management policies, these multivariate analyses of simple presence/absence data provide a basis for sound advice on management. Much of what is advised about aquatic insect conservation is at present based on preconceptions and anecdote (Foster, 1991).

COVERAGE AND FINANCIAL SUPPORT

The extent of coverage of the scheme is better than for most insect recording. Gaps are mainly in Ireland, northern Scotland and the drier parts of England. The situation would be worse were it not for financial support from The Environmental Research Fund to cover intensively agricultural parts of the drainage into the Wash (Foster *et al.*, 1989), the Praeger Fund and the Department of the Environment for Northern Ireland to survey sites in Ireland (Foster *et al.*, 1992), and the British Ecological Society to survey parts of the Western Scottish Mainland (Foster, Spirit & Counsell, 1991). By offering financial support to catalogue collections, some museum services have been instrumental in improving historical coverage of certain areas, but usually not those in which the museums are based!

In its day, the Manpower Services Agency (and related programmes) supported biological surveys which occasionally produced excellent results, in particular that in Caithness and Sutherland (McCann & Moran, 1986).

The erstwhile Nature Conservancy Council (NCC) generated many records for the scheme, by staff employed as entomologists and by occasional funding of surveys (eg Islay — Foster & Eyre, 1988). NCC's staff have been particularly active in surveys of threatened fenlands (e.g. the Somerset Levels — Drake, Foster & Palmer, 1984). Latterly NCC supported the classification and ranking of sites using water beetle assemblage data acquired for the recording scheme, subsequently published by the Joint Nature Conservation Committee (Foster & Eyre, 1992). It remains to be seen whether the country agencies will continue to support studies on water beetles.

It is important to acknowledge the help of staff of the Biological Records Centre in production of record cards and those Balfour-Browne Club newsletters concerned with presentation of preliminary editions of maps.

Having acknowledged financial and logistic support from other organizations, and in particular from certain Club members, it has to be said that, as with most other recording schemes, this one relies for its financial support and continuity on one individual, usually with a long suffering family.

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